Hiroshi HOSHI* & Hiroyoshi OHASHI*: *Sophora franchetiana* Dunn (Leguminosae): Morphology of flowers and pollen grains and its taxonomic position

星 比呂志*・大橋広好*：ツクシムレスズメ（マメ科）の花部形態と花粉形態およびその分類学上の位置

Sophora franchetiana is a very rare species disjunctively distributed in Fujian (=Fukien) in China and southern Kyushu in Japan (Dunn 1908, Koidzumi 1923, Ohashi 1989). This species was recorded from Japan for the first time by Koidzumi (1923) based on specimens collected by K Mayebara in Kumamoto-ken. Then, several localities with a limited number of plants of this species have been added in Kagoshima-ken and Miyazaki-ken (Hatusima 1962). Habitats of this species in Japan are known to be limestone regions.

Tsoong & Ma (1981) proposed a system of genus *Sophora* dividing this into two subgenera, seven sections and 19 series and classified all the then known species into these infrageneric taxa. They put, however, *S. franchetiana* into a group of unknown taxonomic position. They considered that this species may belong to the series Wightianae Tsoong in the section Sophora based on general shape of this plant and more or less lignified reflexed stipules, but the leaflets of this species without well developed reticulate nerves did not support it to be a member of this series. They also stated that petals of this species seemed to resemble that in the series Tetrapterae Tsoong in the section Sophora.

The morphology of this species is not well known in detail due to lack of sufficient materials and no pollen grains have so far been described. In this paper we describe the morphology of this species with emphasis on flowers and pollen grains. Also, we consider the taxonomic position of *S. franchetiana* in the system of Tsoong & Ma (1981).

Material was obtained from living plants cultivated in Biological Institute of Tohoku University in Sendai (voucher specimen: H. Hoshi 1348, TUS). These plants were originally collected along the Kumagawa River in Kumamoto-ken and sent by Professor Y. Hamada of Kumamoto University. For the ob-

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servation of pollen grains with scanning electron microscope (SEM), pollen grains were acetolized (Erdtman 1960) at first. The acetolized grains were dehydrated in an ethanol series, transferred in isoamyl acetate and dried by the critical point method. The dried grains were sputter-coated with gold and examined in a SEM (Jeol JSM-840) at 25 kv accelerating voltage. In the description of tectal perforations, we follow terminology proposed by Ferguson & Strachan (1982).

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Evergreen shrubs about 1 m high, with dense short (0.2–0.5 mm long) lustrous brown appressed hairs (hairs brown on young parts, but often becoming semitransparent on older parts on branchlets) then glabrescent. Leaves odd-pinnate, (9–)11–15-foliolate, 10–20 cm long; stipules lanceolate with an acuminate apex or depressed ovate with a long-acuminate apex, free or connate to the base of leaf rachis, densely appressed brown hairy; rachises 6–15 cm long, with dense appressed brown hairs; leaflets coriaceous, elliptic, ovate or obovate, 2–5 cm long, 1–2.5 cm wide, acute at the apex, obtuse or rotundate at the base, glabrous on upper surfaces, densely appressed brown hairy on lower surfaces, entire, deep green above; petiolules 1–3 mm long, hairy as the rachis.

Inflorescences terminal, 6–15 cm long, racemose, densely flowered; rachises with dense brown appressed hairs; bracts oblanceolate, 2–3 mm long, on pedicels.

Flowers 11.5–13 mm long; pedicels 2.5–4.5 mm long in anthesis, hairy as rachises; calyces tubular, reflexed at the distal end of hypanthium, folded, hairy outside as the rachises, arachnoid with white hairs (less than 0.5 mm long) at the margin, calyx-tubes 3–4 mm long, almost equally 5-lobulate; corollae

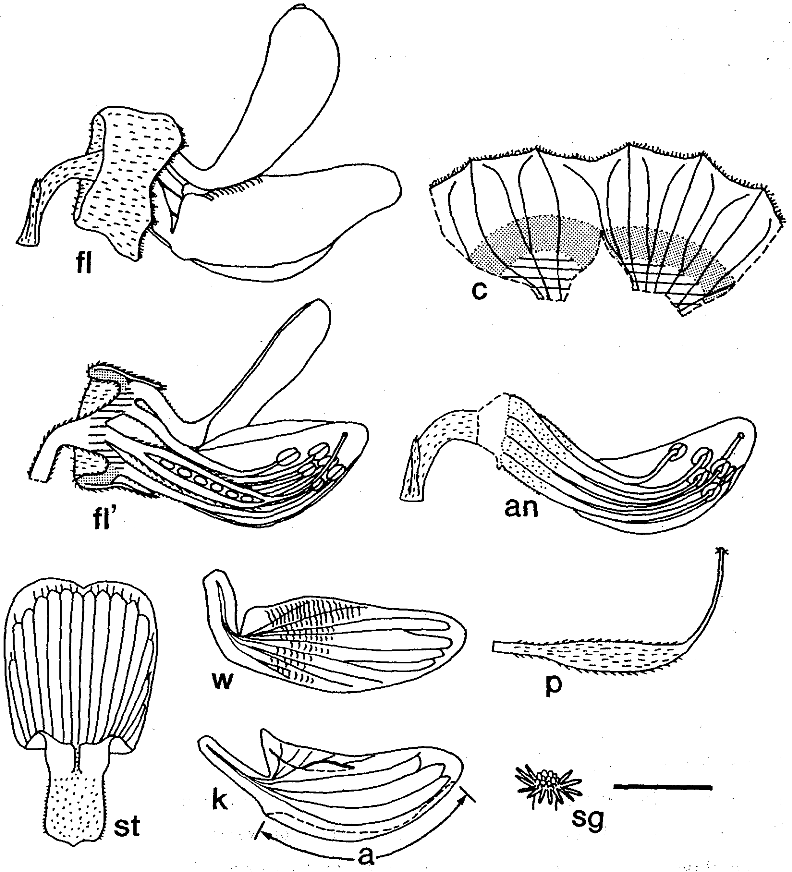

Fig. 1. Flower of *Sophora franchetiana*. fl: flower, fl': dissected flower. st: standard. w: wing. k: keel-petal, abaxial part of laminae overlapping each other in the range of "a" and adhering partly in the middle. c: calyx expanded; horizontal lines show hypanthium and dotted area show thickened area of calyx-tube. an: androecium. p: pistil. sg: stigma. The scale line indicates in "sg" 0.4 mm and in other figures 4 mm long. Voucher specimen: H. Hoshi no. 1348 (TUS).

white; standards curved upwards, the claw 3.5-4.5 mm long, with very minute hairs on below 2/3, sulcate at inner and upper 1/3 part, sulcus often with very minute hairs, the lamina obovate, emarginate, glabrous, 6.5-7 mm long, 5.5-6.5 mm wide, with closed venation system on the lamina; wings semihastate, the

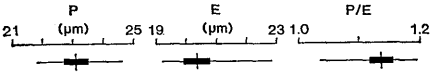

Fig. 2. Variation of pollen size and shape of *Sophora franchetiana* based on 20 grains. P: polar length. E: equatorial diameter. P/E: ratio of polar length and equatorial diameter. Horizontal lines indicate whole range of variation; position of vertical lines is mean value; and width of squares shows standard deviation.

claw 2.5–3.5 mm long, the lamina lanceolate-oblong, 8.5–9.5 mm long, 3.5–4.5 mm wide, with sculptures at base, veinlets closed near the apex; keel-petals semihastate, the claw 2.5–3.5 mm long, the lamina oblong, 7–8 mm long, 3.5–4 mm wide, overlapping and partly adhering each other along the ventral side, veinlets closed near the apex of lamina. Stamens free, curved upwards, ca 10 mm long, hairy at lower part of filaments, anthers elliptic. Pistils ca 12 mm long; gynophores ca 2 mm long; ovaries linear-oblong, 5.5–6.5 mm long, hairy as the calyx; styles 3.5–4.5 mm long; stigma papillate; ovules 3–6.

Pollen grains tricolporate, prolate spheroidal or subprolate (P×E: 21.8–24.6 μm×19.2–22.8 μm), semitriangular in the polar view, compressed oval in the equatorial view; colpi 4/5 length of the polar axis; endoapatures lolongate, ca 11 μm long, ca 7 μm wide; tectum microperforate or perforate in mesocolpium, perforate near colpus, rugulate or verrucate adjacent to colpus, and in apocolpium perforate with the visible collumelae in the lumina.

Sophora franchetiana is characterized in flower by the folded calyces and minute hairs on the claws of standard and on the lower part of filaments. This species is also characterized in the pollen grains by its smaller size, long colpi, large endoapatures and structures of tecta which are microperforate or perforate in mesocolpium and perforate, rugulate or verrucate near colpus.

The flowers of *S. franchetiana* are similar to those of the species of ser. Wightianae in having inconspicuous calyx-lobes, obovate, emarginate standards, sculptures of wings and absence of appendages at the apex of keel-petals. However, *S. franchetiana* is different from species of ser. Wightianae by the terminal inflorescences which are not axillary nor extra-axillary and by the wings which are not unilateral. From the series Tetrapterae, *S. franchetiana* is different in the following characters. The boundary between lamina and claw of the standard is not apparent. The standard is as long as the other petals. From these facts, *S. franchetiana* is considered to be included in series Wightianae of the section Sophora, though further examinations are needed

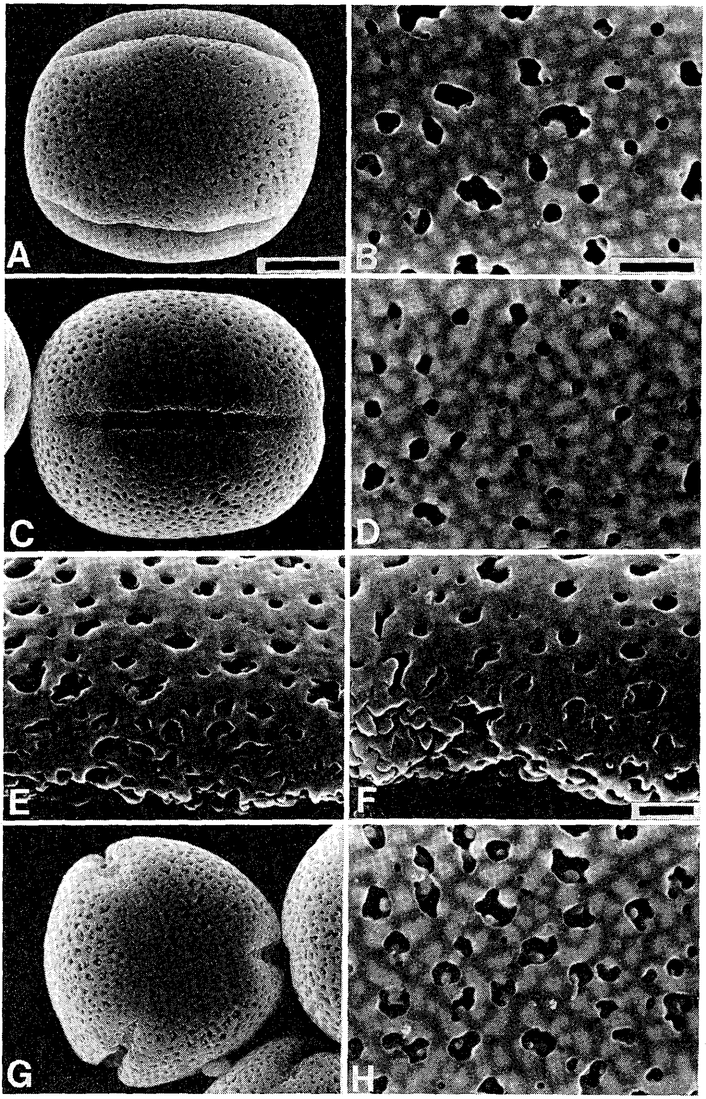

Fig. 3. Pollen morphology of *Sophora franchetiana*. A, C, G: pollen grains (A: equatorial view, C: equatorial view including colporus, G: polar view). B, D: sculpture in mesocolpium. E, F: sculpture near colpus. H: sculpture in apocolpium. Scale lines A, C, G: 5 μm, B, D, H: 1 μm, E, F: 1 μm. Voucher specimen: H. Hoshi no. 1348 (TUS).

based on ample material of species belong to the section Sophora.

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ツクシムレスズメは中国福建省と九州（熊本・宮崎・鹿児島県）の石灰岩地帯に分布するごく稀な種であり，これまで本種の詳しい形態は分かっていなかった。Tsoong & Ma (1981) は彼らのクララ属の分類系の中で，ツクシムレスズメは全体の形と托葉の形態では Wightianae 節に似ているが，葉の脈においては異なっており，花弁の形態では Tetrapterae 節に似ていることを指摘した。しかし，本種の分類学上の位置は不詳であるとしている。本研究に用いたツクシムレスズメは，1984年に熊本大学薬学部の浜田善利氏（現熊本工業大学）から大橋宛に送っていただいたものである。以来，仙台市東北大学理学部生物学教室の実験園（標高約 145 m）の温室で栽培している。

本種は，萼筒が筒状で花托筒の末端部で反曲し再び折れ曲がっていること，旗弁の爪の下半部 2/3 の両面と雄蕊群の下部の両面に微細な毛を生じることが特徴的である。また花粉粒は，小粒であり，長い溝と大きい内口の発芽装置を持ち，外膜模様がメソコルピウムでは微小穿孔紋から穿孔紋であり，溝周辺では穿孔紋，皺状紋または疣状紋であることが特徴的である。花の形態的特徴からツクシムレスズメは Wightianae 節に属すと考えられ，Tetrapterae 節の種とは異なっていることが明らかになった。

終りに，熊本工業大学浜田善利氏にお礼申し上げる。また，本研究は昭和63年度文部省科学研究費補助金一般（B）62480012（代表者 大橋）によるものである。